

Initial tests of 3-km RTMA cloud / surface analysis
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1. INTRODUCTION

This is a report on initial testing of a Real-Time Mesoscale Analysis (RTMA) system to provide 3-km analysis grids of cloud and surface data to be used for frontal; diagnostics, convective initiation assessment, and other near surface assessments, with a 15-min frequency. This work is being completed in collaboration with the Environmental Modeling Center (EMC) of the National Centers for Environmental Prediction (NCEP), using a specially adapted version of the Gridpoint Statistical Interpolation (GSI), a community-supported, revision-controlled, sophisticated variational atmospheric analysis program. GSI was developed and is managed by EMC personnel, and we have closely collaborated with Manuel Pondeva of EMC, who has led the development of the special RTMA surface 2DVAR application of GSI. A version of Pondeva's GSI-based surface 2DVAR is already running operationally at NCEP, ingesting a down-scaled version of the HOURLY operational RAP to provide the current operational RTMA product. This current RTMA product has performed reasonably well, but is limited by the inherent coarse resolution of the underlying RAP grid.

Work by Patrick Hofmann of GSD has focused on adapting the special RTMA 2DVAR GSI code (provided by Manuel Pondeva) for use with the real-time experimental HRRR grids and evaluating and optimizing the resultant 3-km surface analysis fields. A related effort, known as the Rapidly Updating Analysis, RUA) has focused on running the a 3-km version of the GSI-based cloud and precipitation analysis to provide 3-k cloud and hydrometeor analyses. Following a developmental period, both of these analysis efforts have been run in a real-time hourly test set up, using real-time HRRR 1-h forecast fields as input. Real-time experimental testing of both the RTMA and RUA hourly updating system occurred from late fall 2012 through Feb. 2013, but was temporarily suspended in Feb. 2013 to allow for more intensive testing of a more ambitious 3-km HRRR full 3DVAR analysis system. This 3-km HRRR full 3DVAR analysis incorporates four 15-min cycles of a radar reflectivity assimilation, followed by an application of the full GSI 3DVAR analysis at 3-km resolution. The entire hierarchy of these different GSI-based analysis applications (including standard RAP 3DVAR-hybrid analysis) are summarized in Table 1.

Following the RAP/HRRR 2013 code freeze in mid-March, real-time hourly running of both the RTMA and RUA will commence again, with an upgrade to running these analyses every 15 min. coming later in 2013. As part of the RTMA and RUA development and evaluation, real-time web display of analyses and increment (analysis – background, A-B) fields and real-time verification was developed. In this report, I will briefly summarize the scientific development of each analysis product, and show a few selected results and verification statistics.

Fig. 1 Summary of attributes for various GSI-based RAP and HRRR analyses.

	Background	Radar hydro-meteors	Latent Heating scale	Dimensionality	Updated
2013 RAP model initialization	13-km RAP 1 hr fcst	Limited	13-km	3-D hybrid 80-member GFS ensem.	Hourly
2013 HRRR model initialization	13-km RAP	Yes	3-km 1-h pre fcst (4 x 15 min) [+ RAP 13-km]	3-D 3-km 3DVAR	Hourly
Rapidly Updating Analysis (RUA-HRRR)	3-km HRRR 1 hr fcst	Yes	None	3-D cloud analysis only	Hourly
Real-Time Meso Analysis (RTMA-HRRR)	3-km HRRR 1 hr fcst	No	None	2-D (sfc) 3-km 2DVAR	Hourly (15 min planned)

2. RTMA analysis

The RTMA analysis involves running a specially configured version of Manuel Pondeva's 2DVAR version of GSI to ingest HRRR 1-h forecast fields and perform a detailed surface analysis. The key feature in the special 2DVAR version of the GSI is the use of Jim Purser's (NCEP) non-isotropic recursive filter package to allow more customization of the analysis innovation (corrections to the background field) to better fit special surface features, such as terrain and coast lines. The results is a surface analysis that better matches the observed surface data, while providing a coherent field that best matches the various geographically-related features. Samples of the innovations (corrections to the background field) can be seen in Fig. 1.

Surface verification of the RTMA fields indicates the desired outcome of an excellent fit of the analysis to the surface observations. This is illustrated in Fig. 2., which shows that the 3-km RTMA better fits the observations than the corresponding HRRR analysis (down-scaled RAP analysis) for both winds and dew points. Surface temperature fits (not shown) are similar to that of the HRRR.

3km RTMA-HRRR

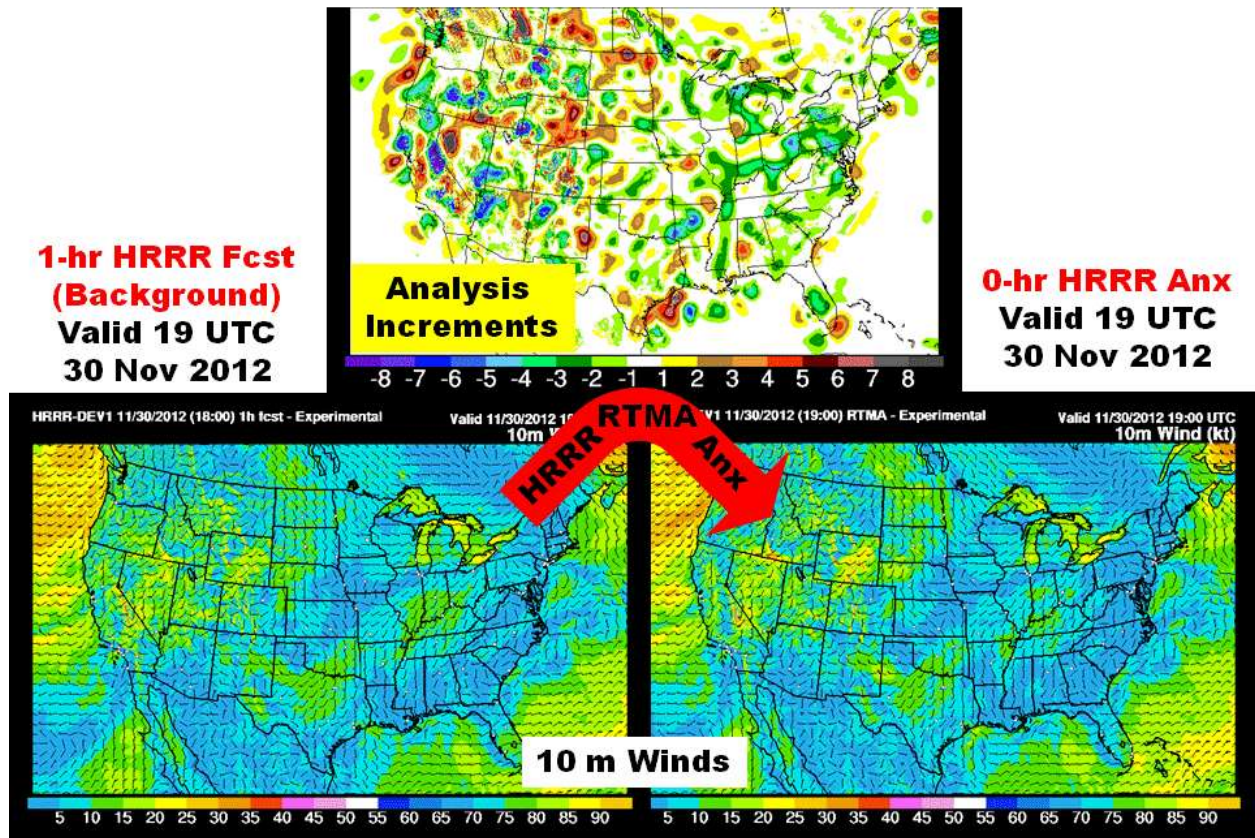


Fig. 1 Sample RTMA innovations (O-A) for surface (10m) wind from 1900 UTC, 30 Nov. 2012 and background and analyzed 10 m wind field.

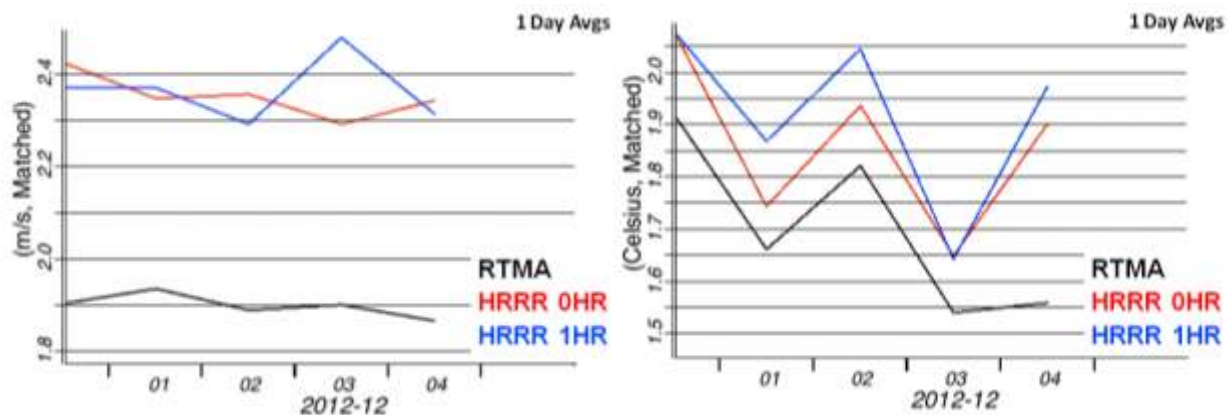


Fig. 2 Verification statistics showing improved fit to surface (METAR) observations for wind and dewpoint from RTMA compared to 1-h HRRR forecast (background) and 0-h HRRR (interpolated from RAP).